SunGuide$^{\text{TM}}$:

Transportation Sensor System Interface Control Document

SunGuide-TSS-ICD-6.2

Prepared for:

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List of Acronyms

ATMS	Advanced Traffic Management System
DOT	Department of Transportation
FDOT	Florida Department of Transportation
ITS	Intelligent Transportation Systems
ITN	Invitation to Negotiate
SwRI	Southwest Research Institute
TMC	Traffic Management Center
TSS	Transportation Sensor System
XML	Extensible Markup Language

REVISION HISTORY

Revision	Date	Changes
1.0.0	November 4, 2004	Initial Release
1.0.2	November 17, 2005	Updated for Release 2 software.
3.0.0	October 16, 2007	Updated for Release 3 software
3.0.1	November 14, 2007	Added “how to use this document” section
4.1.0	September 17, 2008	Updated for new schemas
6.2	March 16, 2016	Updated for release 6.2

1. Scope

1.1 Document Identification

This Interface Control Document (ICD) describes the interface between individual SunGuide^{TM} clients and the Transportation Sensor System (TSS) subsystem and between the TSS subsystem and the associated drivers. The general base architecture of the XML communications including connection information, byte order and base transaction classes is delineated in this document. This ICD defines Extensible Markup Language (XML) schemas upon which XML requests shall be based in communicating amongst the various processes. Refer to the SunGuide-General-ICD document for details regarding data transfer.

1.2 Project Overview

The Florida Department of Transportation (FDOT) is conducting a program that is developing SunGuide software. The SunGuide software is a set of Intelligent Transportation System (ITS) software that allows the control of roadway devices as well as information exchange across a variety of transportation agencies. The goal of the SunGuide software is to have a common software base that can be deployed throughout the state of Florida. The SunGuide software development effort is based on ITS software available from the state of Texas; significant customization of the software is being performed as well as the development of new software modules. The following figure provides a graphical view of the software to be developed:

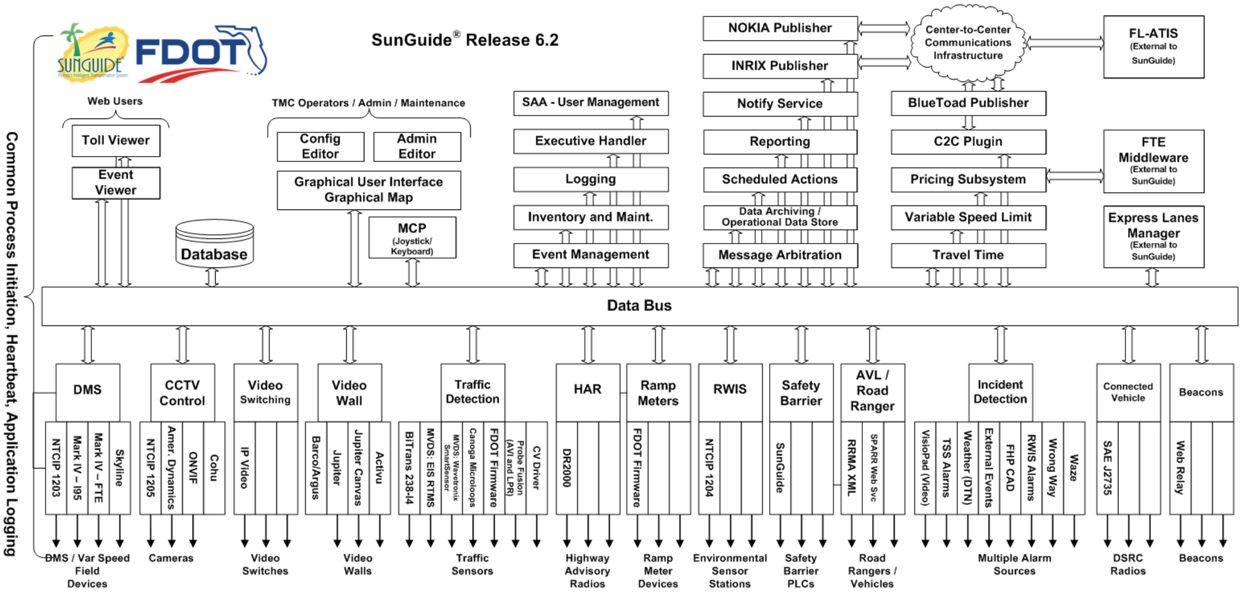

Figure 1-1 - High-Level Architectural Concept

1.3 How to Use This Document

The ICDs describe the specific interface between two SunGuide subsystems or between a SunGuide subsystem and a SunGuide driver. The relationship of appropriate documents is shown in the Figure 1-2.

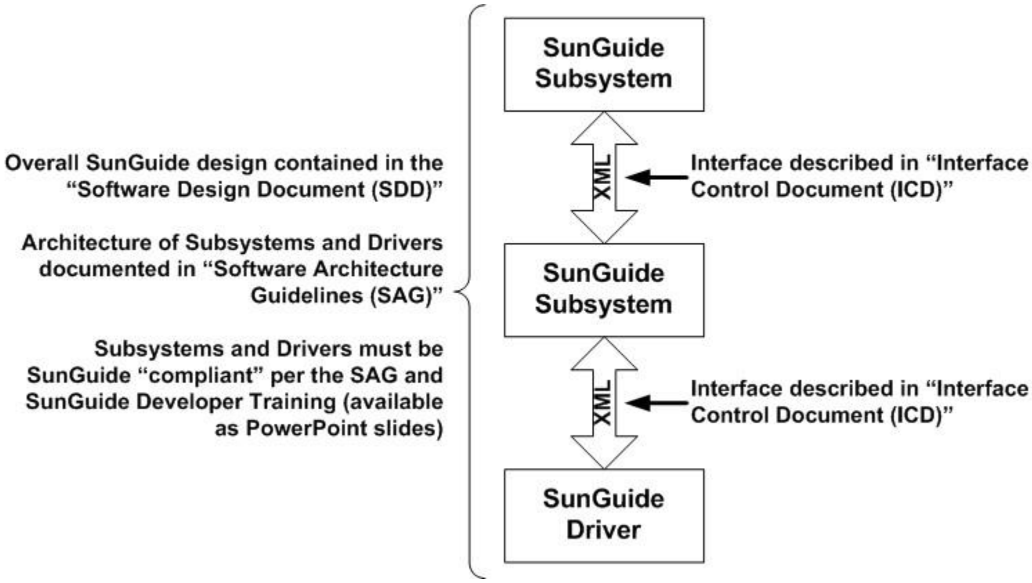
Overall SunGuide design contained in the "Software Design Document (SDD)"
Architecture of Subsystems and Drivers documented in "Software Architecture Guidelines (SAG)"
Subsystems and Drivers must be SunGuide "compliant" per the SAG and SunGuide Developer Training (available as PowerPoint slides)
SunGuide Subsystem
XML
Interface described in "Interface Control Document (ICD)"
SunGuide Subsystem
XML
Interface described in "Interface Control Document (ICD)"
SunGuide Driver

Figure 1-2 - SunGuide Developer Documentation

This document describes an *internal* SunGuide interface. The interface described is between two SunGuide compliant processes. The reader should review the following document to gain an understanding of how SunGuide compliant application is created (this will vary if the application is a driver or subsystem):

SunGuide Software Architecture Guidelines (SAG)

The SAG describes what needs to be included in a SunGuide application to assure that it will work cooperatively in the SunGuide environment. Once the SAG is reviewed, the following document should be reviewed:

SunGuide Software Design Document (SDD)

The SDD will provide an understanding of how individual components of SunGuide were designed. Finally the ICD, along with the associated schema should be reviewed to determine what data needs to be exchanged on the interface being defined in this document.

Additionally, a SunGuide "Developer Training" class is available that provides the students with an introduction into developing SunGuide processes. The SunGuide source code repository has a generic subsystem and a generic driver available that can be used as the basis for developing a new application.

1.4 Related Documents

The following documents were used to develop this document:

- FDOT Scope of Services: *BDQ69, Standard Written Agreement for SunGuide Software Support, Maintenance, and Development, Exhibit A: Scope of Services.* July 1, 2010.
- Notice to Proceed: Letter to Southwest Research Institute® (SwRI®) for BDQ69, July 1, 2010.
- SunGuide Project website: http://sunguidesoftware.com.

1.5 Contacts

The following are contact persons for the SunGuide software project:

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2. Data

The following sections detail the XML transactions that can be exchanged between client and server applications.

2.1 Schema

The schemas for these transactions may be located in the Schemas directory. The objects directory contains common data schemas that are used by the various request, messages, and responses. Schemas are organized in the following tree structure:

- messages
  - addDetectorMsg.xsd
  - addDetectorUpdateMsg.xsd
  - deleteDetectorMsg.xsd
  - detectorUpdateMsg.xsd
  - linkUpdateMsg.xsd
  - mapDetectorMsg.xsd
  - modifyDetectorMsg.xsd
  - modifyPollCycleMsg.xsd
  - onlineStatusMsg.xsd
  - setDynamicLinkingMsg.xsd
  - setOnlineStatusMsg.xsd
  - tagReadMsg.xsd
  - unMapDetectorMsg.xsd
  - updateThresholdsMsg.xsd
- objects
  - alarm.xsd
  - data.xsd
  - detectionZone.xsd
  - detector.xsd
  - detectorDataThreshold.xsd
  - detectorMap.xsd
  - detectorStatus.xsd
  - driverDetectorData.xsd
  - driverDetectorStatus.xsd
  - lane.xsd
  - link.xsd
  - linkGeometry.xsd
  - linkStatus.xsd
  - onlineStatus.xsd
  - status.xsd
  - tssDriver.xsd
  - tssSystemConfiguration.xsd

- requests
    - addDetectorDataThresholdReq.xsd
    - addDetectorReq.xsd
    - deleteDetectorDataThresholdReq.xsd
    - deleteDetectorReq.xsd
    - mapDetectorReq.xsd
    - modifyDetectorDataThresholdReq.xsd
    - modifyDetectorReq.xsd
    - modifyPollCycleReq.xsd
    - onlineStatusReq.xsd
    - retrieveDataReq.xsd
    - setAlarmThresholdsReq.xsd
    - setDynamicLinkingReq.xsd
    - setOnlineStatusReq.xsd
    - setSystemConfigurationReq.xsd
    - subscribeReq.xsd
    - updateRoadwayGeometryReq.xsd
- responses
    - addDetectorDataThresholdResp.xsd
    - addDetectorResp.xsd
    - deleteDetectorDataThresholdReq.xsd
    - deleteDetectorResp.xsd
    - mapDetectorResp.xsd
    - modifyDetectorDataThresholdResp.xsd
    - modifyDetectorResp.xsd
    - modifyPollCycleResp.xsd
    - onlineStatusResp.xsd
    - retrieveDataResp.xsd
    - setAlarmThresholdsResp.xsd
    - setDynamicLinkingResp.xsd
    - setOnlineStatusResp.xsd
    - setSystemConfigurationResp.xsd
    - subscribeResp.xsd
    - updateRoadwayGeometryResp.xsd

Requests may be sent from a client to a subsystem or from a subsystem to a driver. Responses may be sent from a driver to a subsystem or a subsystem to a client. A message can be sent from any process to another process.

2.1.1 Subsystem communication

Initial communication to a subsystem is described in the general ICD. For TSS, the detectors and roadway geometry are retrieved from the database on startup, including any mapping information for a detector. Once a client has initiated the connection to TSS, additional detectors may be added and mapped, existing detectors may be modified, deleted, have the poll cycle modified, request current online status or modify the online status, and the system roadway geometry may be updated. Once a detector has been mapped to links and lanes, thresholds may be set for the links/lanes and highways may be defined using the mapped links and lanes.

When TSS receives a detectorUpdateMsg from a driver, a linkUpdateMsg is generated and sent to subscribed clients. If any alarms have been triggered, updated or canceled, those messages will be sent to subscribed clients as well. If the detectorUpdateMsg contains an error, TSS will not send a linkUpdateMsg to the client. The operational status of the detector will be modified to either Error or Failed (if the device has exceeded the tolerance for communication failure set in the configuration file).

The following table shows the various subscriptions a client may request. The last column shows the XML updates that will be received if a client has subscribed to this data.

Subscription	Description	Updates Received
detectorData	Receive updates to detector configuration information.	addDetectorResp, modifyDetectorResp, deleteDetectorResp
pollCycleUpdate	Receive updates to detector poll cycle information.	modifyPollCycleResp
mapDetectorData	Receive updates to mapping information (detector to links and lanes).	mapDetectorResp
defineHighwayData	Receive updates to highway link and lane information.	defineHighwayResp (deprecated)
thresholdData	Receive updates to alarm threshold settings.	setAlarmThresholdsResp
linkUpdate	Receive detector data updates (speed, volume, occupancy).	linkUpdateMsg
tagReadData	Receive tag read information	tagReadMsg setDynamicLinkingResp
alarmsUpdate	Receive updates to alarms.	alarmCanceledMsg, alarmTriggeredMsg, alarmUpdatedMsg
onlineStatusUpdate	Receive updates to detector operational status.	onlineStatusResp, setOnlineStatusResp
roadwayGeometry	Receive updates to system roadway geometry	updateRoadwayGeometryResp
systemConfigurationData	Receive updates to tss system configuration	setSystemConfigurationResp
receiveUserNotifications	Receive user alert messages	userNotificationMsg
userData	Receive notification of changes to user permissions.	updateSystemDataMsg

2.1.2 Driver communication

Initial communication from a subsystem to a driver is described in the general ICD. For TSS, an addDetectorReq is sent to each driver containing the detectors which belong to the driver. After receiving a response from the driver, the mapDetectorReq is sent to map the zone numbers of the detector to links and lanes. After receiving this request, the driver begins polling the detectors using the polling cycle specified in the addDetectorReq. For each poll, the driver will send a linkUpdateMsg to TSS.

As in Section 2.1.1, additional detectors may be added and mapped, existing detectors may be modified, deleted, have the poll cycle modified, or modify the online status.

2.2 Examples

For example, if a client wishes to add a detector to the system, the client sends an addDetectorReq to the subsystem. Once the subsystem has verified this is a new detector, the request is then forwarded to the appropriate driver. The driver adds the detector and sends an addDetectorResp to the subsystem. The subsystem then sends this response back to the appropriate client and to any clients who have subscribed to detector data.

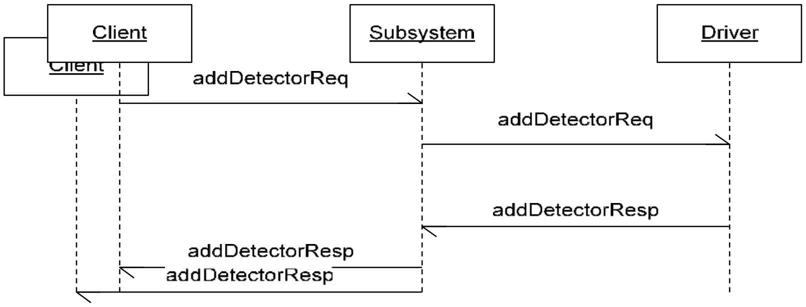

Figure 2-1 - Sample Transaction

The tables below show which requests can be sent from client to subsystem and subsystem to driver. The responses sent from driver to subsystem and subsystem to client are also specified. Messages are sent when a response is not required.

2.3 Subsystem Schemas

FC (From client),TC (To client), TD (To driver), FD (From driver)

Usage Description	Requests	FC	TD	Responses	FD	TC	Messages	TD	FD	TC
Used for a client to add a threshold to an existing detector.	addDetectorDataThresholdReq	X		addDetectorDataThresholdResp		X				
Used for a client to add a new detector to the subsystem.	addDetectorReq	X	X	addDetectorResp	X	X	addDetectorMsg	X		
Used to define an existing roadway as a collection of tss links.	defineHighwayReq	X		defineHighwayResp		X				
Used for a client to remove an existing detector from the subsystem.	deleteDetectorReq	X	X	deleteDetectorResp	X	X	deleteDetectorMsg	X		
Used for a client to remove a threshold from an existing detector.	deleteDetectorDataThresholdReq	X		deleteDetectorDataThresholdResp		X				
The subsystem receives this message from the driver and generates a linkUpdateMsg.							detectorUpdateMsg		X	

Sent from the subsystem when a detectorUpdateMsg has been converted to a linkUpdateMsg.							linkUpdateMsg			X
Used to associate an existing detector with links and lanes.	mapDetectorReq	X	X	mapDetectorResp	X	X				
Sent from the subsystem when a detector is mapped as a notification of new links							mapDetectorMsg			X
Used for a client to modify a threshold on an existing detector.	modifyDetectorDataThresholdReq	X		modifyDetectorDataThresholdResp		X				
Used for a client to modify an existing detector in the subsystem.	modifyDetectorReq	X	X	modifyDetectorResp	X	X	modifyDetectorMsg	X		
Used to modify one or more detectors’ poll cycles	modifyPollCycleReq	X	X	modifyPollCycleResp	X	X	modifyPollCycleMsg	X		
Used to retrieve the online status (Active, Error, Failed, Out of Service) for a detector	onlineStatusReq	X		onlineStatusResp		X	onlineStatusMsg			

Used to retrieve data from TSS, data includes detectors, mapping information, highways and users	retrieveDataReq	X		retrieveDataResp		X				
Used to set alarm thresholds on a link or lanes	setAlarmThresholdsReq	X		setAlarmThresholdsResp		X				
Used to turn on/off dynamic linking for particular links	setDynamicLinkingReq	X		setDynamicLinkingResp		X				
User to set system configuration settings for TSS	setSystemConfigurationReq	X		setSystemConfigurationResp		X				
Used to modify the online status of a detector, possible settings are Active or Out of Service	setOnlineStatusReq	X	X	setOnlineStatusResp	X	X	setOnlineStatusMsg	X		
Used to subscribe to updates from the system. Data includes detector information, mapping, highways, link update messages and alarms.	subscribeReq	X		subscribeResp		X				
Sent from the subsystem on a poll cycle to report all tag reads							tagReadMsg			X

Sent from a subsystem when a detector is deleted to remove associated links							unMapDetectorMsg			X
Used to modify the geographical layout of links for use in mapping applications	updateRoadwayGeometryReq	X		updateRoadwayGeometryResp		X				
Sent to inform clients that a detector mapping has occurred so threshold data may need to be updated.							updateThresholdsMsg			X

2.4 Driver Schemas

TD (To driver), FD (From driver)

Usage Description	Requests	TD	Responses	FD	Messages	TD	FD
Used for a client to add a new detector to the subsystem.	addDetectorReq	X	addDetectorResp	X	addDetectorMsg	X	
Used for a client to remove an existing detector from the subsystem.	deleteDetectorReq	X	deleteDetectorResp	X	deleteDetectorMsg	X	
The subsystem receives this message from the driver and generates a					detectorUpdateMsg		X
Used to associate a detector with links and lanes.	mapDetectorReq	X	mapDetectorResp	X			
Used for a client to modify an existing detector in the subsystem.	modifyDetectorReq	X	modifyDetectorResp	X	modifyDetectorMsg	X	
Used to modify one or more detectors’ poll cycles	modifyPollCycleReq	X	modifyPollCycleResp	X	modifyPollCycleMsg	X	
Used to turn on/off dynamic linking for particular links	setDynamicLinking Req	X	setDynamicLinkingR esp		setDynamicLinkingM sg	X	

Used to modify the online status of a detector, possible settings are Active or Out of Service	setOnlineStatusReq	X	setOnlineStatusResp	X	setOnlineStatusMsg	X	

3. Notes

Information about XML and schemas can be found at the World Wide Web Consortium (W3) website at http://www.w3.org.